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PRODUCTIVITY GAP BY GENDER AMONG RICE FARMERS IN NORTH-CENTRAL NIGERIA

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Abstract: The present research used a field survey data of 2020 rice cropping season to determine yield gap by gender among rice farmers in North-Central Nigeria. A total of 376 farmers were drawn from a sampling frame through a multi-stage sampling technique and a structured questionnaire coupled with interview schedule was used for information elicitation. Both descriptive and inferential statistics were used for data analysis. The empirical evidences showed that most of the farmers have negative attitudes towards risk and this owes to poor resource capital base, thus hinders cultivation of economic holdings. Besides, women farmers were more averse to risk than the men farmers which owes largely to gender discrimination and stereotype induced by culture and religion, thus hindered their access to and control over productive resources. Furthermore, neither gender nor risk attitudinal differentials have impact on the average yield of the farmers. However, it was established that yield gap was largely due to gender and risk attitudinal discriminations. Therefore, the study enjoins the farmers, especially the women folk to harness social capital *viz*. participation in co-operative association- pecuniary advantages, thus enable them to have access to and control over productive resources. In addition, the policymakers are advised to create an enabling agricultural environment for the women folk *viz.* gender budget mainstreaming, thus tackling women farmers' susceptibility to the vicious cycle of poverty.

Keywords: *Gender, Yield, Gap, Rice, Farmers, Nigeria*

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INTRODUCTION

Smallholder farmers are the heroes who provide a great deal of food in the world, but they are also the poorest and most malnourished. Globally, 2.5 billion smallholder farmers make daily decisions to protect their livelihoods and nourish their communities (Digital Green, no date). Every day, these farmers receive a staggering amount of information from government extension officers, private agribusinesses, and NGOs. Farmers are given information and services that they have not requested and cannot use; and are forced to make obscure decisions due to poor coordination between these actors. The gap between what is needed and what is offered continues to widen as climate change increasingly threatens development, and as supply chains are disrupted by crises like COVID-19.

In sub-Saharan Africa, growth in agricultural productivity has been described as a key driver of poverty reduction and increased food security (Ligon and Sadoulet, 2008; Sepahvand, 2019). These goals are formalized by the United Nations Agenda 2030 as the Sustainable Development Goal (SDG) 1 (No Poverty) and SDG 2 (Zero Hunger). When women farmers have the same access to productive resources as men, they can increase yields by 20 to 30 percent, according to Sepahvand (2019). In developing countries, this could potentially increase overall agricultural output by 2.5 to 4 percent and lift 100 to 150 million people

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out of hunger. Recent literature, however, argues that lower female productivity, or female farmers' inability to respond to economic incentives, is due to their inability to take higher risks. For example, in their study, Averett et al.(2018) found that in the higher payoff treatments, gender gap disappears when women show a greater willingness to take risk. However, empirical literature has shown that because of risk domains (Dohmen et al., 2011; 2012) and elicitation techniques, the presence and magnitude of gender differences in risk taking can change (Charness et al., 2013).

The quantity of essential inputs, such as fertilizers, seeds and labor, in sub-Saharan Africa can lead to gender differences in agricultural productivity, even if female and male farmers have the same underlying agricultural production function, although the same technique is used for similar crops (Amber et al., 2014). In addition, the quality of the critical inputs used in agricultural production may vary between male and female farmers as well. This could be due to legal standards that restrict the rights of women to have access to high-quality land or soil (Cotula, 2006; Sepahvand, 2019). The belief, however, that female and male farmers in agriculture have the same underlying output function does not always hold. Most likely, this is because crop choices vary by gender. In explaining gender differences in agricultural productivity, cultural norms play an important role as they affect crop choices. Another major reason for variations in crop choices by gender is credit limitation. This credit limitation can cause the female farmers' output frontier to persist under that of males, indicating lower female productivity.

Succinctly, agriculture is a risky activity: farmers work in risky and unpredictable circumstances in developing countries (Di Falco and Chavas, 2009; Sepahvand, 2019). The risk attitudes of farmers are an important factor which affects their decisions on farm production, investment and management. Higher-payoff practices and investments will be avoided by farmers less likely to take risk (Alderman, 2008). Farm households are vulnerable to climate variability and demand fluctuations. These shocks could place farmers in a position to have nothing or to lose what they have. Agricultural risk-taking is also influenced by the geographical isolation of development regions and restricted access to credit or insurance coverage (Sepahvand, 2019). Wealth is also correlated with a greater willingness to take chances in agriculture, as wealthier farm households engage in more risky decisions and receive higher returns as a result (Sepahvand, 2019).

The main objective of this study is to enhance understanding of the relationship between risk-taking and gender-based productivity in agriculture. In order to identify potential policy recommendations to minimize gender disparities in agricultural productivity, understanding how these factors affect productivity differences is fundamental. These policies are of particular importance in promoting and supporting the SDGs with a view to achieving sustainable development with reduced hunger, higher food security and higher agricultural productivity, improved livelihoods and equality between women and men. This will provide valuable feedback for policy initiatives to mitigate the gender gap in agricultural productivity. This research will contribute to/add to the literature by specifically examining the risk taken by female farmers and its effects on agricultural productivity using a broad, representative sample of farmers.

Therefore, this research attempted to determine rice productivity gap by gender among rice farmers in North-Central Nigeria. While the specific objectives were to determine the risk attitudes of the farmers vis-à-vis gender; determine the factors affecting rice productivity among the farmers; determine the impact of gender and risk attitude differentials on farmers' yield; and, determine the effect of gender and risk behaviour discriminations on farmers' yield.

RESEARCH METHODOLOGY

The North-Central region is geographically located in the middle belt of Nigeria and consists of six states viz. Benue, Nasarawa, Niger, Plateau, Kogi and Kwara; and a Federal unity territory called Abuja. The region spanned from the west to around the serenity of the confluence of two major rivers-River Niger and River Benue. The geographical co-ordinates of the region are latitude 10˚ 20′ and longitude 7˚ 45′; and its vegetation cover is largely guinea savannah alongside mountainous and tropical vegetations. The mean cumulative annual and monthly rainfall of the region are 1247.52 ± 166.68 mm and 103.96 mm, respectively; while the annual mean temperatures hovered around minimum and maximum values of 22.55 ± 0.42˚C and 33.54 ± 0.23˚C. The mean is slightly above 50 percent for the relative humidity and varied between the small range of 50.08 and 52.75 percent. The distribution of monthly rainfall ranges from May to October, with a uni-modal peak in August (274.23mm) (Olayemi et al., 2014). The months of January and February are completely dry season (no rainfall) while the months of April and November witnessed little spring, thus referenced as pre and post-rainy season transition periods respectively. The inhabitants of the region majorly engaged in arable crop production alongside tree cropping, fishing, hunting, artisanal, civil service and Ayurvedic medicines. In achieving a representative sampling size, a multi-stage sampling technique was adopted. With the exception of Benue state, all the state units and the Federal unity territory are suitable for cultivation of rice. Thus, three out of the seven units viz Niger and Kogi States; and FCT Abuja were conveniently selected. Given the preponderance of rice cultivation across the chosen units, two Local Government Areas (LGAs)/Municipal Area Councils (MAC) were randomly selected from each of the selected units using Microsoft inbuilt sampling analytical tool. Furthermore, using the same Microsoft sampling analytical tool, two villages were randomly selected from each of the chosen LGAs/MAC. Based on the sampling frame sourced from the States' Agricultural agencies and reconnaissance survey, a scale ratio of 18% was used to determine the representative sample size (Table 1). Thus, a total of 376 active rice farmers that made the sample size were drawn through simple random sampling technique. However, 16 out of the 376 questionnaires retrieved contained outliers, thus were eliminated. Therefore, a total of 360 valid questionnaires were subjected to the analysis. Using an easy cost route approach, a structured questionnaire complemented with interview schedule is the instrument used to elicit cross-sectional data of 2020 rice cropping seasons from the farmers. Objective I, II, III and IV were achieved using Sadiq-Singh-Makarfi risk safety approach; Average treatment effect; and, Oaxaca-Blinder decomposition models respectively.

Table 1: Sampling frame of rice farmers

States	**LGAs/MACs**	**Villages**	**Sample frame**	**Sample size**
FCT Abuja	Kwali	Dabi	85	15
		Gada-biu	109	20
	Abaji	Yaba	100	18
		Pandagi	90	16
Kogi State	Yagba West	Omi	198	36
		Ejiba	220	40
	Kogi	Giryan	250	45
		Panda	180	32
Niger State	Borgu	Swashi	208	37
		Saminaka	170	31
	Katcha	Katcha	238	43
		Badeggi	242	43
Total	**6**	**12**	**2090**	**376**

Source: States' Agricultural Agencies, 2020
Note: District unit is called Municipal Area Council (MAC) and Local Government area (LGA) in FCT Abuja and State respectively.

Empirical model

Tobit regression model

Given that censored regression model yield similar estimates with linear probability model (LPM); and LPM not suitable for qualitative variables due to classical regression assumptions, the equation was fitted into censored regression model. Following

Tobin (1958) as specified by Sadiq *et al*.(2020a & b), the Tobit regression model is presented below:

$Y_i^* = \alpha + X\beta + \varepsilon_i$ .... (1)

$Y_i^* = \alpha + X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + \cdots . + X_n\beta_n + \varepsilon_i$.................. (2)

Where:

Y_i* = Yield value for i[th] farmer;

X_1 = Age (years); X_2 = Gender (male=1, female=0); X_3= Marital status (married =1, otherwise = 0); X_4 = Education (years); X_5 = Household size (number); X_6 = Experience (year); X_7 = Mode of land acquisition (inheritance =1, otherwise =0); X_8 = Distance from house to farm (DHF) (kilometer); X_9= Distance from house to market (DHM)(kilometer); X_{10}= Co-operative membership (yes = 1, otherwise = 0); β_0 = Intercept; β_{1-n} = Vector of parameters to be estimated; and, ε_i = Chance.

Sadiq-Singh-Makarfi risk safety approach model:

Step 1:

Exploratory factor analysis: The exploratory factor-principal component analysis was used to reduce the production variables- output and inputs to weight. The Kaiser Mayer Olkin (KMO) test of sampling adequacy attained a mediocre level with a value of 0.692, greater than the threshold value of 0.50 benchmarked by Kaiser (1974) to be suitable for analysis. This indicates that there is a common variable applicable to all the factors and the sample is adequate. Besides, the Bartlett's Sphericity test (BST) was significant at 1 percent, indicating that the rotated variables are not identity matrix. The Varimax rotated matrix generated four factors based on Eigen-value greater than unity and these factors accounted for 69.72% of the total variation (Table 2).

Table 2: Varimax rotation factor of production components

Items	**EV**	**% of Var.**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Output	2.318	28.975	0.631			
Labour	1.183	14.793		0.704		
Fertilizer	1.055	13.188				0.966
Seed	1.021	12.768	0.653			
Herbicides			0.799			
Pesticides					0.886	
Capital Dep.			0.753			
Farm size				0.801		
Total		**69.724**				
KMO	**0.692**					
BST	**362.65 (0.000)*** **					

Source: Field survey, 2020

Note: value in parenthesis is probability value; EV= Eigen value; Var. = Variance

Step 2: To obtain the risk index, the production variables were normalized- Z-score normalization and then multiplied by their respective weight generated from the Varimax rotation. Presented below is the risk index model:

Normalization index

$I_i = \frac{P_i - \bar{P}}{SD}$ .... (3)

Where I_i is the normalized value of the i[th] farmer for a production component indicator; P_i is the actual production component value of i[th] farmer; $\bar{P}$ is the average value of the production component; and, SD is the standard deviation value of the production component.

$R_i = \frac{\sum_{k=1}^{n} W_k I_k}{\sum_{k=1}^{n} W_k}$ .... (4)

This can further be expressed as:

$$R_i = \frac{W_Y I_Y + W_{X1} I_{X1} + W_{X2} I_{X2} + W_{X3} I_{X3} + W_{X4} I_{X4} + W_{X5} I_{X5} + W_{X6} I_{X6} + W_{X7} I_{X7} + W_{X8} I_{X8}}{W_Y + W_{X1} + W_{X2} + W_{X3} + W_{X4} + W_{X5} + W_{X6} + W_{X7} + W_{X8}} \ldots\ldots\ldots\ldots (5)$$

Where, R_i = risk index; W = weight; Y= output (kg); X1-X8 are human labour, inorganic fertilizer, seeds, herbicides, pesticides, depreciation on capital items and farm size respectively.

Average Treatment Effect (ATE)

ATE: It show the average difference in outcome between units assigned to the treatment and units assigned to the placebo (control). Following Lokshin and Sajaia (2011); Wang *et al*. (2017); Sadiq *et al*. (2020a & b) the equation is given below:

Yield index of male farmers/ risk non-averse is given by:

$$E(y_{1i} | I = 1; X) \ldots\ldots\ldots (6)$$

Yield index of female farmers/ risk non-averse is given by:

$$E(y_{2i} | I = 0; X) \ldots . (7)$$

Yield index of male farmers/risk non-averse if there is no gender/risk difference is denoted by:

$$E(y_{2i} | I = 1; X) \ldots\ldots (8)$$

Yield index of female farmers/ risk non-averse if there is gender/risk difference:

$$E(y_{1i} | I = 0; X) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where:

$E(.)$ = Expectation operator

y_{1i} = yield index of male farmers/ risk non-averter farmers (dependent variable)

y_{2i} = yield index of female farmers/ risk averter farmers (dependent variable)

I = Dummy variable (1 = male/risk non-averter, 0 = female/ risk averter)

X = Explanatory variables that is common to both male and female farmers/ risk non-averter and averter farmers.

$$\text{ATT} = E(y_{1i} | I = 1; X) - E(y_{2i} | I = 1; X) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$ATU = E(y_{1i} | I = 1; X) - E(y_{2i} | I = 1; X) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Average Treatment effect on Treated = ATT

Average Treatment effect on Untreated = ATU

Equations (10) and (11) were further simplified as:

$$\text{ATT} = \frac{1}{N_1}\sum_{i=1}^{N_1}[p(y_{1i} | I = 1; X) - p(y_{2i} | I = 1; X)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$\text{ATU} = \frac{1}{N_2}\sum_{i=1}^{N^2}[p(y_{2i} | I = 0; X) - p(y_{1i} | I = 0; X)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Where, N_1 and N_2 are number of male farmers/ risk non-averter farmers and female farmers/risk averter farmers respectively, and *p*= probability.

Oaxaca-Blinder Decomposition model

Using the standard Oaxaca-Blinder procedure (Oaxaca 1973; Blinder 1973) the extent to which the risk gap between the male and female farmers/ risk non-averter and averter farmers can be explained by differences in observed human capital characteristics (Marwa, 2014; Revathy *et al.*, 2020; Sadiq *et al.*, 2020a&b).

$$ln\bar{Y}_{W/RN} = \beta_0 + \beta_i \sum_{i=1}^{i} X_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots (14)$$

$$ln\bar{Y}_{M/RP} = \beta_0 + \beta_i \sum_{i=1}^{i} X_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

Where,

$\bar{Y}_{W/RN}$ = average yield of women folk/ risk negative (risk averse) attitude farmers;

$\bar{Y}_{M/RP}$ = average yield of men folk/ risk positive (risk non-averse) attitude farmers;

$X_{i-n} = explanatory\ variables$;

$\beta_0 = intercept$;

$\beta_{i-n} = parameter\ estimates$; and,

$\varepsilon_i = stochastic\ term$.

Following Revathy *et al.*(2020); Sadiq *et al.* (2020a&b), equations 14 and 15 of the Oaxaca-Blinder decomposition can be explained as follow:

$$(ln\bar{Y}_F - ln\bar{Y}_M) = (\beta_{F0} - \beta_{M0}) + [\beta_{F1}(\bar{X}_{F1} - \bar{X}_{M1}) + \beta_{F2}(\bar{X}_{F2} - \bar{X}_{M2}) + \beta_{F3}(\bar{X}_{F3} - \bar{X}_{M3}) + \beta_{F4}(\bar{X}_{F4} - \bar{X}_{M4}) + \beta_{Fn}(\bar{X}_{Fn} - \bar{X}_{Mn})] + [\bar{X}_{M1}(\beta_{F1} - \beta_{M1}) + \bar{X}_{M2}(\beta_{F2} - \beta_{M2}) + \bar{X}_{M3}(\beta_{F3} - \beta_{M3}) + \bar{X}_{M4}(\beta_{F4} - \beta_{M4}) + \bar{X}_{Mn}(\beta_{Fn} - \beta_{Mn}) + (\varepsilon_F - \varepsilon_M) \ldots \ldots \ldots \quad (16)$$

The yield gap is divided into two segments: one is the proportion attributable to differences in the endowments generating activities $(\bar{X}_F - \bar{X}_M)$ evaluated at the female group returns (β_F). This is taken as a reflection of endowment differential and it's termed endowment/characteristics/explained effect. The second segment is attributable to the difference in the returns $(\beta_F - \beta_M)$ that the female and male groups get for the same endowment generating activities$(\bar{X}_F)$. This segment is often taken as a reflection of discrimination viz. gender/risk attitudes and its termed discrimination or unexplained effect.

RESULTS AND DISCUSSION

Farmers' Risk Behaviours

Most of the farmers (61.1%) have negative attitude (risk averter) towards risk and the possible reason is due to their poor capital resource base, thus cultivation of thinly uneconomic holdings with little or no capacity for balanced marketable surplus (Table 3). This category of farmers farm exclusively for home consumption, and if there is a surplus, though very rare, they will sell it in the market. Often these farmers are struggling with the basic survival of themselves and families. While they may be entrepreneurial in spirit, they usually lack the opportunity to produce as entrepreneurs because they are rarely in the position to commit their minds and bodies to entrepreneurship. Though, 34.7% of the farmers were risk neutral- produced partly for home consumption and market; while 4.2% were risk lover- innovators that exclusively produced for the market. In the risk-neutral category two sets of farmers exist- farm mostly for home consumption but with the intention of selling surplus in the market; and those that produced partly for home consumption and partly for market. The risk neutral category can be presumed to understand the value of farming for the market but often they are limited by access to finance and market information. For the former farmers, they have greater opportunities that allow them to produce just beyond survival, thus viewed as 'pre-entrepreneurial', requiring support to move into independent position. In true sense, at this level, they are not entrepreneurs neither are they truly market-oriented. Though the opportunities are limited, but by changing their resource mix and overcoming access and risk issues, opportunities can be expanded. While for the latter, they are on the path towards developing profit-driven rice farming business as they possessed the skills, but they cannot risk household food security without greater certainty of income from rice crop. The risk preference farmers are entrepreneurs that are mainly driven by profit, thus produced for the market.

The gender decomposition results showed the women farmers to be more risk averse (63.2%) than their men counterparts (60.6%) while on the other hand the men folk were more risk neutral (34.9%) and risk lover (4.5%) than the women folk (risk neutral: 33.8%; risk preference: 2.9%) (Table 3). On the average, most of the women and men farmers are risk averse and risk neutral respectively, as evidenced by their respective risk index that are -0.0618 and 0.0144, respectively. The possible reason for this negative skewed risk averse of the women farmers may be attributed to the consequences of cultural and religious barriers-gender discrimination and gender stereotype, thus hindered women access and control over productive resources. Generally, it can be inferred that most of the farmers are not disposed to risk preference due to limited access to capital and market information despite that most of them have market-focus, thus government effort towards revising the chasm-achieving self-sufficiency in rice production in the region is likely to be a mirage.

Table 3: Risk attitudes vis-à-vis gender and co-operative participation

Risk attitude index	**Overall**	**Men**	**Women**
Risk averse (<0.00)	220(61.1)	177(60.6)	43(63.2)
Risk neutral (0-0.99)	125(34.7)	102(34.9)	23(33.8)
Risk preference (≥ 1.00)	15(4.2)	13(4.5)	2(2.9)
Total	260(100)	292(100)	68(100)
Mean	-0.02936	0.014409	-0.061875
Minimum	-0.6932	-0.6859	-0.6932
Maximum	2.5878	2.5878	1.5095

Source: Authors' own computation, 2020
Note: value in ( ) is percentage; CP and NCP are co-operative participation and non-cooperative participation respectively.

Determinants of Yield

The significant of the LR Chi^2 at 1% probability level implies that the censored regression is best fit for the specified equation (Table 4). In addition, it implies that the estimated parameters are different from zero at 10% probability level. Besides, all the predictor variables were within the variance inflation factors (VIF) threshold of 10.00, thus indicating absence of orthogonality. The residual of the estimated model was normally skewed as evidenced by the non-significant of the Chi^2 test statistic at 10% significance level. Thus, it can be inferred that the chosen model is reliable for prediction with certainty, efficiency and consistency.

Farmers' yield were influenced by marital status, household size, farming experience, distance from house to market and co-operative membership as indicated by their respective estimated coefficients that are within the acceptable margin of 10% probability level. The positive significance of marital status revealed how the quest to sustain family livelihood incentivized married farmers to engage in sustainable rice production, thus increase in their yield. In addition, access to twin capital-social and economic serves as impetus for married farmers' access to procure rice technologies, thus increase in their rice yield. The marginal and elasticity implications of being married would increase farmers yield by 0.24 and 2.77% respectively. The negative sign and significant of the household coefficient showed how labour drift to white collar jobs among the able-bodied household members plummeted farmers yield. In addition, high household expenditure *viz.* medics and food affected the farmers' poor income base-capital investment, thus plummeted yield due to farmers' weak wherewithal to adopt innovative rice technologies. Thus, the marginal and elasticity implications of a unit increase in a farmer's household size by one person will lead to a decrease in his/her yield by 0.53 and 3.15% respectively.

The positive sign and significant of the experience coefficient revealed how managerial efficiency-mix in resource allocation, among the experienced farmers enhanced their yield level. Therefore, the marginal and elasticity implications of an addition one year experience will increase farmers yield by 0.008 and 1.01% respectively. The positive sign and significant of the distance from house to market coefficient showed that high farm efficiency *viz.* adequate concentration on farm activity other than non-farm and off-farm activities in the commercial centers among the farmers that have their abodes far apart from the market centers enhanced their yield. Therefore, the marginal and elasticity implications of a unit increase from a farmer's house to market by one kilometer will increase his/her yield by 0.005 and 0.27% respectively. The positive sign and significant of the co-operative coefficient indicated that pecuniary advantages *viz.* economies of scale among farmers that belonged to co-operative association enhanced their yield level. Thus, the marginal and elasticity implications of a farmer being a co-operative member will makes his/her yield to be higher than that of his counterpart farmer that didn't belong to co-operative association by 0.14 and 1,38% respectively.

However, explanatory variables *viz.* risk index, age, gender, educational level, mode of land acquisition and distance from home to farm were non-significant, but their signs convey empirical information. The positive sign of the risk index coefficient implied that farmers that have positive attitudes towards risk have high yield level. The negative sign of the age coefficient indicated that low labour productivity that owed to decline in labour efficiency among aged farmers plummeted yield. The positive sign of gender coefficient showed that access to and control over productive resources enhanced men farmers yield when compared to their women counterparts. The positive sign of educational level showed how innovation reception and search for market information among the literate farmers enhanced their yield.

Table 4: Determinants of yield among the rice farmers

Variable	Coefficient	t-stat	Elasticity	VIF
Intercept	6.8405(0.1949)	35.09***	-	-
Risk index	0.0182(0.0697)	0.262^{NS}	0.0000128	1.180
Age	−8.72e-5(0.0036)	0.023^{NS}	-0.0008648	1.597
Gender	0.0215(0.0823)	0.261^{NS}	0.0023155	1.038
Marital status	0.2430(0.1008)	2.410**	0.0277027	1.334
Education	0.0022(0.0065)	0.348^{NS}	0.0026578	1.060
Household size	−0.0532(0.0159)	3.346***	-0.0314524	1.734
Experience	0.0081(0.0046)	1.759*	0.0106941	1.065
Mode of land acquisition	−0.0202(0.0727)	0.278^{NS}	-0.001824	1.026
Distance from home to farm	0.0044(0.0099)	0.449^{NS}	0.0026921	1.135
Distance from home to market	0.0573(0.0083)	6.913***	0.0432765	1.191
Co-operative org.	0.1404(0.0722)	1.943*	0.0138544	1.052
Chi^2	95.81[0.000]***			
Normality test	3.22[0.199]^{NS}			

Source: Field survey, 2020

Note: *** ** * & NS mean significant at 1, 5, 10% and non-significant respectively.

Values in ( ) and [ ] are standard error and probability value respectively.

Impact of Gender and Risk on Farmers' Yield

All the treatment effect estimators *viz*. regression adjustment, inverse-probability weights, nearest-neighbor matching and propensity score matching showed that gender differential has no impact on the yield of the farmers as evidenced by their respective average treatment effect (ATE) coefficients which were not different from zero at 10% degree of freedom (Table 5). Though non-significant, the ATE estimated coefficient of the regression adjustment been 163.08, indicates that the average yield level of the men farmers is marginally higher than of the women farmers by 163.08 kg (7.87%). Furthermore, within each stratum, there is gender equity in yield distribution as indicated by their respective average treatment effect on treated (ATET) coefficients of all the treatment effect estimators that are not within the acceptable margin of 10% degree of freedom.

The empirical evidences showed that the extent of risk behaviour-risk differential has no impact on the average yield level of the farmers as indicated by the respective ATE coefficients of all the treatment effect estimators that are outside the plausible margin of 10% probability level (Table 6). The possible explanation is that most of the farmers are resource poor, smallholders, cultivating thinly uneconomic holding; with an output that lagged behind a balanced marketable surplus. Therefore, it can be inferred that there is no significant difference between the average yield levels of farmers that are negatively and positively disposed to risk. In other word, disposition to risk, either positively or negatively, has no impact on the average yield level of farmers. In addition, the use of unimproved varieties affected the correlation of yield with the degree of risk intensity. Though non-significant, the ATE coefficient of the regression adjustment been 97.04, implies that the average yield of positive risk attitude farmers is slightly higher than that of the risk averse' farmers by 97.04 kg (4.82%). Furthermore, except the ATET coefficient of inverse-probability weight, in each of the stratum- negative and positive risk attitudes, all the other treatment effect estimators revealed equal yield distribution among farmers with negative attitudes towards risk; likewise those with positive attitudes towards risk.

Table 5: Impact of gender on farmers' yield

Items	Coefficient	t-stat	Coefficient	t-stat
	Regression adjustment		**Inverse-probability weight**	
ATE	-163.08(279.40)	0.58^{NS}	-293.70(400.82)	0.73^{NS}
ATET (Men)	246.80(252.01)	0.98^{NS}	227.04(249.07)	0.91^{NS}
ATET (Women)	-143.58(293.81)	0.49^{NS}	-309.44(447.25)	0.69^{NS}
Men (mean)	2072.49(277.75)	7.46***	2206.67(399.35)	5.53***
Women (mean)	1909.41(68.14)	28.02***	1912.97(68.00)	28.13***
	Nearest-neighbor matching		**Propensity-score matching**	
ATE	-3.33(264.83)	0.01^{NS}	-680.00(520.99)	1.31^{NS}
ATET (Men)	324.20(281.20)	1.15^{NS}	302.05(202.24)	1.49^{NS}
ATET (Women)	71.38(274.87)	0.26^{NS}	-768.01(600.47)	1.28^{NS}

Source: Field survey, 2020

Note: ATE and ATET mean Average treatment effect and Average treatment effect on treated, respectively.

Note: *** ** * $^{\&\ NS}$ means significant at 1%, 5%, 10% & Non-significant, respectively.

Figure in ( ) is standard error

Table 6: Impact of risk attitudes on farmers' yield

Items	Coefficient	t-stat	Coefficient	t-stat
	Regression adjustment		**Inverse-probability weight**	
ATE	97.03(164.23)	0.59	65.35(155.13)	0.42
ATET (PRA)	98.15(160.56)	0.61	130.13(161.14)	0.81
ATET (NRA)	-96.32(175.51)	0.55	-25.43(163.71)	0.16
PRA (mean)	2014.89(148.09)	13.61	1970.10(138.31)	14.24
NRA (mean)	1917.86(80.01)	23.97	1904.75(77.59)	24.55
	Nearest-neighbor matching		**Propensity-score matching**	
ATE	172.05(157.38)	1.09	220.54(246.86)	0.89
ATET (PRA)	327.29(180.89)	1.81	273.08(185.34)	1.47
ATET (NRA)	-73.26(179.39)	0.41	-187.11(332.48)	0.56

Source: Field survey, 2020

Note: ATE and ATET mean Average treatment effect and Average treatment effect on treated, respectively.

Note: *** ** * $^{\&\ NS}$ means significant at 1%, 5%, 10% & Non-significant, respectively.

Figure in ( ) is standard error; PRA = Positive risk attitude; NRA = Negative risk attitude.

Effects of Gender and Risk Discriminations on Yield Gap

A cursory review of the gender-wise results showed endowment factors *viz*. risk index, marital status, educational level, household size, experience and distance from house to market contributed favourably to women farmers' yield; while age, mode of land acquisition, distance from house to farm and co-operative membership contributed favourably to the yield of the men farmers (Table 7). The difference between the coefficients of the predictor variables vis-à-vis simultaneous equation-between the men and women yield equations; were the major factors that contributed to the yield gap between the two genders. Furthermore, the empirical evidences showed that 72.09% of the yield gap was largely caused by discrimination effect called gender while 27.91% owed to endowment effect called characteristic factors. With an average yield of 1883.30 and 2268.40 kg for women and men farmers respectively, the yield gap is 385.10kg. Out of the yield gap of 385kg, the difference due to superior endowment of the men gender accounted for 107.46kg while gender discrimination *viz*. access to and control over productive resources, and gender stereotype accounted for 277.64kg. Thus, the consequence of gender discrimination made women farmers to lost 277.64kg of rice output per hectare. Besides, the discrimination value represents 14.72% of the actual average yield of women gender. Given the technology at the disposal of the women farmers, without gender discrimination, their actual average yield should be 2160.94 kg. The estimated yield gap is -18.61% (i.e. $ln\bar{Y}_W - ln\bar{Y}_M = -0.1861$), the resource endowment effect is 19.09% [i.e. $(\bar{X}_W - \bar{X}_M)\hat{\beta}_W = 0.1909$], and the discrimination effect is 49.32% [i.e. $(\hat{\beta}_W - \hat{\beta}_M)\bar{X}_M = 0.4932$] (Figure 1). The positive sign of the endowment effect coefficient implies that relative to men farmers, women farmers on the average have more characteristics that are associated with high productivity.

On the other hand, the risk-wise results showed age, gender, educational level, household size, mode of land acquisition and distance from house to farm to be the endowed factors that contributed favourably to the yield of farmers with negative disposition towards risk (Table 8). While endowed factors viz. marital status, experience, distance from house to market and co-operative membership contributed favourably to the yield of farmers with positive attitude towards risk. Thus, the predictor coefficient differentials between the farmers with negative attitude towards risk and those with positive disposition towards risk from the two-yield equation were the major factors that contributed to yield gap. Of the yield gap, discrimination effect called risk attitudes-opportunities accounted for 86.47% of the yield gap while endowment effect called idiosyncratic factors accounted for 13.53% of the yield gap. With an average yield of 1865.88 and 2093.01kg respectively for the risk averter and non-risk averter farmers, the yield gap is 227.12kg. Out of the yield gap of 227.12kg, the difference due to the superior endowment of the farmers with positive disposition towards risk accounted for 30.72kg while discrimination in risk attitudes accounted for 196.40kg. Thus, due to risk attitudinal discrimination, the risk averter farmers lost 196.40kg of rice output per hectare. The value of the discrimination represents 10.53% of the actual average yield of risk averter farmers. Given the technology at the disposal of the risk averter farmers, without risk behaviour discrimination, their actual average rice yield should be 2062.28kg. The estimated yield gap is -11.49% (i.e. $ln\bar{Y}_{RN} - ln\bar{Y}_{RP} = -0.1149$), the resource endowment effect is -8.4% [i.e. $(\bar{X}_{RN} - \bar{X}_{RP})\hat{\beta}_{RN} = -0.084$], and the discrimination effect is -53.58% [i.e. $(\hat{\beta}_{RN} - \hat{\beta}_{RP})\bar{X}_{RP} = -0.5358$] (Figure 1). The negative sign of endowment effect coefficient means that relative to the risk averter farmers, on the average, farmers with positive attitudes towards risk have more characteristics that are associated with high yield.

Generally, it can be inferred be inferred that yield gap was entirely due to gender and risk attitudinal discriminations in the studied area.

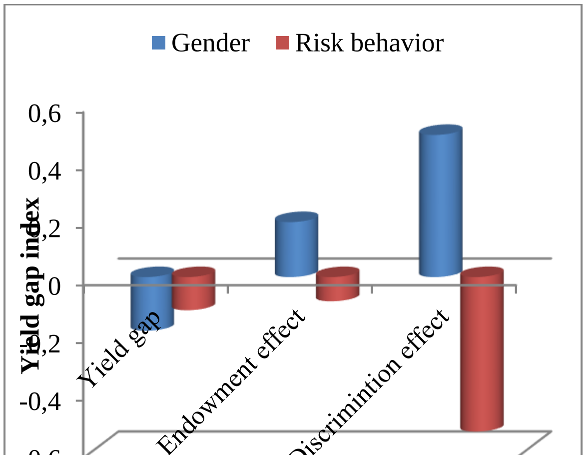

Figure 1: Yield gap vis-a-vis gender and risk behavior

Table 7: Productivity gap by gender

Items	**Female**	**Male**	$\bar{X}_F$	$\bar{X}_M$	$\beta_F(\bar{X}_F - \bar{X}_M)$	$\bar{X}_M(\beta_F - \beta_M)$
Intercept	6.350679	6.961687				-0.61101
Risk index	-0.13943	0.075062	-0.06188	0.014409	0.010637	-0.00309
Age	0.001735	0.00217	41.074	41.592	-0.0009	-0.01808
Marital status	0.463365	0.183042	0.89706	0.83219	0.030058	0.233282
Education	0.019113	-0.00122	8.5882	7.9658	0.011896	0.161957
Household size	-0.1405	-0.05054	3.9118	4.4178	0.071093	-0.39741
Experience	0.020387	0.003961	10.221	9.5514	0.013651	0.156892
Mode of land acquisition	-0.16079	-0.01298	0.76471	0.72945	-0.00567	-0.10782
Distance from home to farm	0.033492	-0.00038	4.1029	4.399	-0.00992	0.148988
Distance from home to market	0.084456	0.049826	6.3971	5.5137	0.074608	0.190939
Co-operative organization	0.273658	0.097219	0.70588	0.7226	-0.00458	0.127494
Average yield	**1883.3**	**2268.4**				
Yield gap		**-385.1**				
Endowment effect					**0.190883**	
Discrimination effect						**0.493151**
Overall effect						**0.684034**
% from overall effect					**27.90545**	**72.09455**
Contribution to Gap					**-107.464**	**-277.636**
Without Discrimination					**2160.936**	**2160.936**
% of Discrimination in yield						**14.742**

Source: Field survey, 2020

Table 8: Productivity gap by risk attitudes

Items	NRA	PRA	$\bar{X}_{NRA}$	$\bar{X}_{PRA}$	$\beta_N(\bar{X}_N - \bar{X}_P)$	$\bar{X}_P(\beta_N - \beta_P)$
Intercept	7.004293	6.464656				0.539637
Age	-0.00023	0.001851	41.43182	41.56835	3.17E-05	-0.08656
Gender	-0.01973	0.161325	0.804545	0.820144	0.000308	-0.14849
Marital status	0.306355	0.081974	0.831818	0.863309	-0.00965	0.19371
Education	0.000742	0.012034	8.254545	7.856115	0.000296	-0.08871
Household size	-0.06312	-0.03261	4.113636	4.647482	0.033695	-0.14179
Experience	0.005933	0.012349	9.345455	10.1295	-0.00465	-0.06499
Mode of land acquisition	-0.09746	0.132064	0.731818	0.741007	0.000896	-0.17008
Distance from home to farm	-0.00942	0.015662	4.043182	4.805755	0.007187	-0.12056
Distance from home to market	0.061149	0.054313	5.072727	6.669065	-0.09761	0.045594
Co-operative organization	0.133885	0.075076	0.677273	0.784173	-0.01431	0.046116
Average yield	**1865.882**	**2093.005**				
Yield gap		**-227.123**				
Endowment effect					**-0.08381**	
Discrimination effect						**-0.53578**
Overall effect						**-0.61959**
% from overall effect					**13.52729**	**86.47271**
Contribution to Gap					**-30.7236**	**-196.399**
Without Discrimination					**2062.281**	**2062.281**
% of Discrimination in yield						**10.5258**

Source: Field survey, 2020

Note: NRA= Negative risk attitude; PRA= Positive risk attitude

CONCLUSION AND RECOMMENDATIONS

Based on the findings it can be concluded that most of the farmers have negative attitudes towards risk and it owes largely to poor capital resource base. Besides, women farmers were found to be more averse to risk than their men counterparts; and it owes to gender discrimination *viz*. culture and religion barriers that hinder women farmers' access to and control over productive resources. Further, neither gender differential nor risk behaviour differential has impact on the average yield of the farmers. However, it was established that yield gap was largely due to gender and risk attitudinal discriminations. Therefore, based on the foregoing, the study advised the farmers, especially women folk, to utilize social capital pool so as to have access to productive resources *viz*. pecuniary advantages. By so doing, it will break the chain of gender discrimination and stereotype. In addition, the policymakers should create enable agricultural environment for women farmers *viz* gender budget mainstreaming, thus reducing women farmers' vulnerability to vicious cycle of poverty.

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